

Naturalizing consciousness emergence for ai implementation purposes: A guide to multilayered management systems

Vallverdú J., Talanov M.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2017, IGI Global. All rights reserved. The purpose of this chapter is to delineate a naturalistic approach to consciousness. This bioinspired method does not try to emulate into a 1:1 scale real mechanisms but instead of it, we capture some basic brain mechanisms prone to be implemented into computational frameworks. Consequently, we adopt a functional view on consciousness, considering consciousness as one among other cognitive mechanisms useful for survival purposes in natural environments. Specifically, we wish to capture those mechanisms related to decision-making processes employed by brains in order to produce adaptive answer to the environment, because this is the main reason for the emergence and purpose of consciousness.

<http://dx.doi.org/10.4018/978-1-5225-1947-8.ch002>

References

- [1] Ansorge, U., Kunde, W., & Kiefer, M. (2014). Unconscious vision and executive control: How unconscious processing and conscious action control interact. *Consciousness and Cognition*, 27, 268-287. doi:10.1016/j.concog.2014.05.009 PMID:24960432
- [2] Ari, C., & D'Agostino, D. P. (2016). Contingency checking and self-directed behaviors in giant manta rays: Do elasmobranchs have self-awareness? *Journal of Ethology*, 34(2), 1-8. doi:10.1007/s10164-016-0462-z
- [3] Armstrong, A. M., & Dienes, Z. (2013). Subliminal understanding of negation: Unconscious control by subliminal processing of word pairs. *Consciousness and Cognition*, 22(3), 1022-1040. doi:10.1016/j.concog.2013.06.010 PMID:23933139
- [4] Baars, B. (1988). *A Cognitive Theory of Consciousness*. Cambridge, UK: Cambridge University Press.
- [5] Baars, B. J., & Franklin, S. (2009). Consciousness is computational: The Lida model of global workspace theory. *International Journal of Machine Consciousness*, 1(1), 23-32. doi:10.1142/S1793843009000050
- [6] Bargh, J. A., & Morsella, E. (2008). The Unconscious Mind. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, 3(1), 73-79.
- [7] Barron, A. B., Sovik, E., & Cornish, J. L. (2010). The roles of dopamine and related compounds in reward-seeking behavior across animal phyla. *Frontiers in Behavioral Neuroscience*, 4, 1-9. doi:10.3389/fnbeh.2010.00163 PMID:21048897
- [8] Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology*, 59(1), 617-645. doi:10.1146/annurev.psych.59.103006.093639 PMID:17705682
- [9] Bayne, Y., Cleeremans, A., & Wilken, P. (2009). *The Oxford Companion to Consciousness*. Oxford, UK: OUP. doi:10.1093/acref/9780198569510.001.0001
- [10] Bromberg-Martin, E. S., & Hikosaka, O. (2009). Midbrain dopamine neurons signal preference for advance information about upcoming rewards. *Neuron*, 63(1), 119-126. doi:10.1016/j.neuron.2009.06.009 PMID:19607797

- [11] Chalmers, D. J. (1995). Facing up to the Problem of Consciousness. *Journal of Consciousness Studies*, 2, 200-219.
- [12] Cleeremans, A. (2008). Consciousness: the radical plasticity thesis. *Prog Brain Res.*, 168, 19-33.
- [13] Cleeremans, A. (2011). The Radical Plasticity Thesis: How the Brain Learns to be Conscious. *Frontiers in Psychology*, 2, 86.
- [14] Cohen, M. M., & Dennet, D. (2011). Consciousness cannot be separated from function. *Trends in Cognitive Sciences*, 15(8), 358-364. doi:10.1016/j.tics.2011.06.008 PMID:21807333
- [15] Costa, V. D., Tran, V. L., Turchi, J., & Averbeck, B. B. (2014). Dopamine modulates novelty seeking behavior during decision making. *Behavioral Neuroscience*, 28(5), 556-566. doi:10.1037/a0037128 PMID:24911320
- [16] Crick, F. (1995). *Astonishing Hypothesis: The Scientific Search for the Soul*. Scribner.
- [17] Crick, F., & Koch, C. (2003). A framework for consciousness. *Nature Neuroscience*, 23(2), 119-126. doi:10.1038/nn0203-119 PMID:12555104
- [18] Damasio, A. (1994). *Descartes*. New York: Gosset/Putnam Press.
- [19] Damasio, A. (1999). *The Feeling of What Happens. Body and Emotion in the Making of Consciousness*. London: Heinemann.
- [20] de Gardelle, V., & Kouider, S. (2009). Cognitive theories of consciousness. In W. Banks (Ed.), *Elsevier Encyclopedia of Consciousness*. Elsevier. doi:10.1016/B978-012373873-8.00077-3
- [21] Dennett, D. (1990). Quining Qualia. In W. Lycan (Ed.), *Mind and Cognition* (pp. 519-548). Oxford, UK: Blackwell.
- [22] Dennett, D. C. (1991). *Consciousness Explained*. Boston: Little, Brown and Company.
- [23] Donchin, E., & Coles, M. G. H. (1998). Context updating and the p300. *Behavioral and Brain Sciences*, 21(1), 152-154. doi:10.1017/S0140525X98230950
- [24] Edelman, G. (1989). *The Remembered Present: A Biological Theory of Consciousness*. New York: Basic Books.
- [25] Frégnac, Y., & Laurent, G. (2014). Where is the brain in the Human Brain Project? *Nature*, 513(7516), 27-29. doi:10.1038/513027a PMID:25186884
- [26] Gigerenzer, G., Hertwig, R., & Pachur, T. (Eds.). (2011). *Heuristics: The foundations of adaptive behavior*. New York: Oxford University Press. doi:10.1093/acpr of:oso/9780199744282.001.0001
- [27] Gossman, J., & Eliasmith, E. (2016, February22). Optimizing Semantic Pointer Representations for Symbol-Like Processing in Spiking Neural Networks. *PLoS ONE*, 1-18.
- [28] Gregory, R. L. (1988). Consciousness in science and philosophy: conscience and con-science. In *Consciousness in Contemporary Science*. Oxford, UK: Oxford Science Publications.
- [29] Hills, T. (2006). Animal foraging and the evolution of goal-directed cognition. *Cognitive Science*, 30(1), 3-41. doi:10.1207/s15516709cog0000_50 PMID:21702807
- [30] Hills, T., & Butterfill, S. (2015). From foraging to autonoetic consciousness: The primal self as a consequence of embodied prospective foraging. *Current Zoology*, 61(2), 368-381. doi:10.1093/czoolo/61.2.368
- [31] Hollenstein, M., Koenig, T., Kubat, M., Blaser, D., & Perrig, W. J. (2012). Nonconscious word processing in a mirror-masking paradigm causing attentional distraction: An ERP-study. *Consciousness and Cognition*, 21(1), 353-365. doi:10.1016/j.concog.2012.01.005 PMID:22289507
- [32] Jackendoff, R. (1987). *Consciousness and the computational mind*. Cambridge, MA: MIT Press.
- [33] Kihlstrom, J. F. (1987). The cognitive unconscious. *Science*, 237(4821), 1445-1452. doi:10.1126/science.3629249 PMID:3629249
- [34] Kihlstrom, J. F. (1994). The rediscovery of the unconscious. In H. Morowitz & J. L. Singer (Eds.), *The mind, the brain, and complex adaptive systems* (pp. 123-143). Reading, MA: Addison-Wesley Publishing Co, Inc.
- [35] Kihlstrom, J. F., Mulvaney, S., Tobias, B. A., & Tobis, I. P. (2000). The emotional unconscious. In E. Eich, J. F. Kihlstrom, G. H. Bower, J. P. Forgas, & P. M. Niedenthal (Eds.), *Cognition and emotion* (pp. 30-86). New York: Oxford University Press.
- [36] Komer, B., & Eliasmith, C. (2016). A unified theoretical approach for biological cognition and learning. *Current Opinion in Behavioral Sciences*, 11, 14-20. doi:10.1016/j.cobeha.2016.03.006
- [37] Kouider, S., & Dehaene, S. (2007). Levels of processing during non-conscious perception: A critical review of visual masking. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 362(1481), 857-875. doi:10.1098/rstb.2007.2093 PMID:17403642
- [38] Lau, H. C. (2008). A Higher-Order Bayesian Decision Theory of Perceptual Consciousness. *Progress in Brain Research*, 168, 35-48. doi:10.1016/S0079-6123(07)68004-2 PMID:18166384
- [39] Limb, C. J., & Braun, A. R. (2008). Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation. *PLoS ONE*, 3(2).
- [40] Llinas, R. R. (2001). *I of the Vortex. From neurons to Self*. Cambridge, MA: MIT Press.
- [41] Lövheim, H. (2012). A new three-dimensional model for emotions and monoamine neurotransmitters. *Medical Hypotheses*, 78, 341-348.

- [42] Minsky, M. (2007). *The emotion machine: Commonsense thinking, artificial intelligence, and the future of the human mind*. Simon & Schuster.
- [43] Montemayor, C., & Haladjian, H. H. (2015). *Consciousness, Attention, and Conscious Attention*. Cambridge, MA: MIT Press. doi:10.7551/mit-press/9780262028974.001.0001
- [44] Oizumi, M., Albantakis, L., & Tononi, G. (2014, May). From the Phenomenology to the Mechanisms of Consciousness: Integrated Information Theory 3.0. *PLoS Computational Biology*, 10(5), e1003588. doi:10.1371/journal.pcbi.1003588 PMID:24811198
- [45] Olsson, J. (2015). An evaluation of the integrated information theory against some central problems of consciousness, Bachelor Degree Project. University of Skövde.
- [46] O'Regan, J. K., & Noë, A. (2001). A sensorimotor account of vision and visual consciousness. *Behavioral and Brain Sciences*, 24(5), 883-917. doi:10.1017/S0140525X01000115 PMID:12239892
- [47] Prinz, J. J. (2005). A neurofunctional theory of consciousness. In A. Brook & K. Akins (Eds.), *Cognition and the brain: Philosophy and neuroscience movement* (pp. 381-396). Cambridge, UK: Cambridge University Press. doi:10.1017/CBO9780511610608.012
- [48] Reynolds, R. F., & Bronstein, A. M. (2003). The broken escalator phenomenon: Aftereffect of walking onto a moving platform. *Experimental Brain Research*, 151(3), 301-308. doi:10.1007/s00221-003-1444-2 PMID:12802549
- [49] Rolls, E. T. (2010). *Consciousness, Decision-Making and Neural Computation*. In A. Hussain & J. G. Taylor (Eds.), *Cutsuridis, Vassilis* (pp. 287-333). Perception- Action Cycle, Germany: Springer.
- [50] Skoggard, I., & Waterson, A. (2015). Introduction: Toward an Anthropology of Affect and Evocative Ethnography. *Anthropology of Consciousness*, 26(2), 109-120. doi:10.1111/anoc.12041
- [51] Talanov, M. (2015). *Neuromodulating Cognitive Architecture: Towards Biomimetic Emotional AI*. 2015 IEEE 29th International Conference on Advanced Information Networking and Applications. <http://doi.ieeecomputersociety.org/10.1109/AINA.2015.240>
- [52] Taylor, J. G. (2010). Article. In V. Cutsuridis, A. Hussain, & J. G. Taylor (Eds.), *A Review of Models of Consciousness* (pp. 335-357). Perception-Action Cycle, Germany: Springer.
- [53] Thagard, P., & Steward, T. C. (2014). Two theories of consciousness: Semantic pointer competition vs. information integration. *Consciousness and Cognition*, 30, 73-90. doi:10.1016/j.concog.2014.07.001 PMID:25160821
- [54] Tononi, G. (2008). Consciousness as integrated information: A provisional manifesto. *The Biological Bulletin*, 215(3), 216-242. doi:10.2307/25470707 PMID:19098144
- [55] Tononi, G., & Koch, C. (2015). Consciousness: here, there and everywhere? *Phil. Trans. R. Soc. B*, 370. DOI:10.1098/rstb.2014.0167
- [56] Tulving, E. (1985). Memory and consciousness. *Canadian Psychology*, 26(1), 1-12. doi:10.1037/h0080017
- [57] Turner, M., & Fauconnier, G. (2002). *The Way We Think. Conceptual Blending and the Mind's Hidden Complexities*. Basic Books.
- [58] Vallverdu, J. (2012). Subsuming or Embodying Emotions?. In J. Vallverdu (Ed.), *Creating Synthetic Emotions through Technological and Robotic Advancements*. IGI Global Group. doi:10.4018/978-1-4666-1595-3
- [59] Vallverdu, J. (2015). A cognitive architecture for the implementation of emotions in computing systems. *Biologically Inspired Cognitive Architectures*. doi:10.1016/j.bica.2015.11.002
- [60] Vallverdu, J. (2016). *Bayesians Versus Frequentists. A Philosophical Debate on Statistical Reasoning*. Springer. doi:10.1007/978-3-662-48638-2
- [61] Vallverdu, J., Talanov, M., Distefano, S., Mazzara, M., Manca, M., & Tchitchigin, A. (2016). NEUCOGAR: A Neuromodulating Cognitive Architecture for Biomimetic Emotional AI. *International Journal of Artificial Intelligence*, 14(1), 27-40.
- [62] van Gaal, S., de Lange, F. P., & Cohen, M. X. (2012a). The role of consciousness in cognitive control and decision making. *Frontiers in Human Neuroscience*, 6, 121. doi:10.3389/fnhum.2012.00121 PMID:22586386
- [63] van Gaal, S., & Lamme, V. A. (2012). Unconscious high-level information processing: Implication for neurobiological theories of consciousness. *The Neuroscientist*, 18(3), 287-301. doi:10.1177/1073858411404079 PMID:21628675
- [64] Wegner, D. (2002). *The Illusion of Conscious Will*. Cambridge, MA: MIT Press.
- [65] Weiss, J. (1997). The role of pathogenic beliefs in psychic reality. *Psychoanalytic Psychology*, 14(3), 427-434. doi:10.1037/h0079734
- [66] Winkielman, P., & Schooler, J. W. (2011). Splitting consciousness: Unconscious, conscious, and metaconscious processes in social cognition. *European Review of Social Psychology*, 22(1), 37-41. doi:10.1080/10463283.2011.576580
- [67] Zatorre, R. J., Chen, J. L., & Penhune, V. B. (2007). When the brain plays music: Auditory-motor interactions in music perception and production. *Nature Reviews. Neuroscience*, 8(7), 547-558. doi:10.1038/nrn2152 PMID:17585307